These clearly indicated phylogenetic relations have a direct bearing on the location of the center of origin of the Crepidinae. Extensive evidence has already been presented (cf. Babcock, 1947, Pt. I, Ch. 6, especially pp. 96–97) that both *Soroseris* and *Dubyaea* originated in central Asia and migrated southeast and south to their present areas of distribution. The discovery of this primitive species of *Youngia* in Alaska suggests a similar origin and migrational history to that of *Crepis,* section *Ixeridopsis.* In addition to this section, all of the other native American species of *Crepis* were unquestionably derived from species or hybrids that must have migrated across Beringea in Tertiary times. This evidence, together with the well justified assumption (Babcock, 1947, pp. 108, 137–139) that some of the *Crepis* species of northern Europe and of Iceland (*C. paludosa*) or their ancestors migrated westward south of the Ural Mountains in early Miocene, points to a northern central Asiatic origin of *Crepis.* Now, in *Youngia americana,* we find additional support for the concept of a northern Asiatic origin of the Crepidinae.

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CYTOTAXONOMIC STUDIES IN THE GENUS SORGHUM. II. TWO NEW SPECIES FROM AUSTRALIA

E. D. Garber and L. A. Snyder

In a recent taxonomic revision of the genus *Sorghum,* Garber (1950) recognized six subgenera: *Eu-Sorghum, Chaetosorghum, Heterosorghum, Sorghastrum, Para-Sorghum,* and *Stiposorghum.* Among the subgenera, *Para-Sorghum,* and *Stiposorghum* form one circle of affinity and the other subgenera constitute a second circle of affinity.

The basic chromosome number of *Sorghum* is 5 and is known only in *Para-Sorghum* and *Stiposorghum.* The application of cytological methods to the taxonomic problems of this genus and especially of the subgenera *Para-Sorghum* and *Stiposorghum* has been eminently successful. A cytological study of a collection of Australian sorghums, using criteria previously validated in defining species of these subgenera, has revealed the presence of two undescribed species.

Materials and Methods

Herbarium specimens of Australian sorghums furnished by

Mr. S. T. Blake, Botanic Gardens, Brisbane, Queensland, yielded a small number of seed which were planted in Berkeley, California. For cytological study, immature panicles were fixed in a fresh solution of absolute alcohol and glacial acetic acid (3:1) for 24 hours and then transferred to 70 per cent alcohol for storage. Pollen mother cell smears were stained with acetocarmine.

Taxonomy

Specimens number 17526 and 17536 of Blake's collections were identified as *Para-Sorghum* and *Stiposorghum,* respectively, but could not be identified as any known species. An examination of the meiotic chromosomes gave additional evidence of the distinctiveness of these collections.

Sorghum australiense sp. nov. Planta annua, culmorum nodis dense barbatis, ramis primariis verticillatis plerumque simplicibus, pulvino parvo, spicularum sessilium callo obtusissimo spiculis sessilibus 7.0–8.5 m. longis, aristis 35–48 mm. longis, lodiculis glabris cupuliformibus crassis, spiculis pedicellatis masculinis vel neutris 6.5–8.0 mm. longis, fructu obovato. Chromosomae 2n = 20.

Annual; nodes of the culms, at least the upper, bearded; primary branches of the panicle whorled, usually simple; callus of the sessile spikelets obtuse; pulvinus not prominent; sessile spikelets 7.0–8.5 mm. long, brown; awns 35–48 mm. long; lodicules glabrous, cup-shaped, thick; pedicelled spikelets staminate or neuter, lacking lemmas, 6.5–8.0 mm. long; mature caryopsis obovoid. Chromosomes 2n = 20.

Type. East of Mataranka, near Elsey Station, Northern Territory, Australia, April 29. 1947, *S. T. Blake 17526* (Herbarium, Botanic Gardens, Brisbane, Queensland).

Sorghum australiense is the first annual *Para-Sorghum* found east of India. The other annual species in the subgenus, *S. purpureo-sericeum* and *S. versicolor,* are restricted to western India and eastern Africa.

The glabrous, cup-shaped, thick lodicules of *S. australiense* are unique among the species of *Para-Sorghum* that have been examined. Pilger (1940), however, has placed *S. trichocladum,* a species with glabrous lodicules occurring in western Mexico and northern Guatemala, in the subgenus *Para-Sorghum.* Until living material of this species is available for cytotaxonomic study, this disposition cannot be verified. Within the subgenus, only *S. versicolor* has longer awns than *S. australiense.* Of the five species of *Para-Sorghum,* the three annual species have relatively long awns (27–54 mm.), and the two perennial species, short awns (12.5–24.0 mm.).

More than 200 spikelets of an open pollinated plant of *S. australiense* were examined and yielded no seed. Until extensive populations are available for hybridization, it is not possible to

decide whether sterility is due to self-incompatibility as in *S. leiocladum,* a tetraploid species of *Para-Sorghum,* or to environmental factors. Using stainability with cotton blue in lactophenol as a criterion of pollen viability, approximately 80 per cent of the pollen grains appear to be functional.

Sorghum matarankense sp. nov. Planta annua culmorum nodis dense barbatis, ramis primariis verticillatis plerumque simplicibus, pulvino parvo, spicularum sessilium callo acuminato 1.0 mm. longo, spiculis sessilibus 6.0–6.5 mm. longis, lodiculis ciliolatis membranaceis, spiculis pedicellatis masculinis 6.0–7.0 mm. longis, fructu late subulato. Chromosomae 2n = 10.

Annual; nodes of the culms, at least the upper, bearded; primary branches of the panicle whorled, usually simple; pulvinus not prominent; callus of the sessile spikelets pointed, 1.0 mm. long; sessile spikelets 6.0–6.5 mm. long, brown; awns 35–50 mm. long; lodicules ciliate, membranaceous; pedicelled spikelets staminate, 6.0–7.0 mm. long; mature caryopsis broadly subulate. Chromosomes 2n = 10.

Type. East of Mataranka, near Elsey Station, Northern Territory, Australia, April 29, 1947, *S. T. Blake, 17536* (Herbarium, Botanic Gardens, Brisbane, Queensland).

The short, pointed callus of the sessile spikelets in *S. matarankense* is also found in *S. brevicallosum* and serves to distinguish these species from the others in *Stiposorghum.* The shorter sessile spikelets, 6.0–6.5 mm. compared with 7.5–8.5 mm., and longer awns, 40–50 mm. compared with 38–43 mm. distinguish *S. matarankense* from *S. brevicallosum.* The very short hairs of the bearded nodes in the former species contrasts with the long hairs of the bearded nodes in the latter species. The primary branches, especially in the lowermost whorls, are usually divided, a character not yet observed in any species of *Stiposorghum.* Similar to the situation in *Para-Sorghum,* the one known perennial species in *Stiposorghum, S. plumosum,* has short awns (28–50 mm.) compared with the four known annual species (38–85 mm.).

From more than 200 spikelets of an open pollinated plant of *S. matarankense,* no seed was obtained. Whether this sterility is due to self-incompatibility or environmental factors is not known. This observation, however, is not unexpected since the species of *Stiposorghum* are characteristically self-incompatible.

Cytology

Sorghum australiense with a somatic chromosome number of 20 is a tetraploid. Since two plants had different numbers of rings of four chromosomes at diakinesis and metaphase I of meiosis, it is not possible to decide whether this species is an allotetraploid or autotetraploid. At any rate, the three Australian species of *Para-Sorghum* are tetraploids and the two African species, diploids. Since the three Australian species are either autotetraploid or allo-

tetraploid, there is reason to believe that additional collections of *Para-Sorghum* from Australia may yield diploid species.

The meiotic chromosomes of *S. australiense* are similar in morphology to those of the other species of the subgenus at pachytene, diakinesis, and metaphase I. The chiasmata frequently at diakinesis and metaphase I was determined for one plant, A50/3–4. It had up to four rings of four chromosomes at these stages. Consequently, the data on chiasmata frequency had to be expressed as the mean number of half chiasmata per chromosome. At diakinesis, the mean number of half chiasmata per chromosome was 1.90 (26 PMC's) compared with 1.58–2.42 for the other species of *Para-Sorghum,* and at metaphase I, 1.79 (25 PMC's), compared with 1.50–2.04 for the other species.

Approximately 50 per cent of the pollen mother cells (26 of 50 PMC's) had more than one nucleolus at pachytene; two pollen mother cells had three nucleoli at the same stage. The nucleolus organizing region was heteropycnotic; the nucleolus chromosome in cells with only one nucleolus was associated with the nucleolus at an intercalary position, thus distinguishing this species from the other two tetraploid species with terminal nucleolus organizing regions.

Sorghum matarankense with a somatic chromosome number of 10 is the fourth diploid species of *Stiposorghum.* The meiotic chromosomes at pachytene, diakinesis, and metaphase I are similar in morphology to the chromosomes of the other species of *Stiposorghum* at the same stages. The mean number of chiasma per chromosome at diakinesis was 0.61 (40 PMC's) compared with 0.55–0.60 for the other diploid species, and at metaphase I, 0.60 (27 PMC's), compared with 0.52–0.55 for the other diploid species. The percentage of bivalents with one chiasma at diakinesis was 78 per cent (40 PMC's), and at metaphase I, 80 per cent (27 PMC's) compared with 78.9–88.9 per cent and 89.0–96.0 per cent for the other diploid species at the respective stages.

Two of the five bivalents in *S. matarankense* were associated with one nucleolus at pachytene, an observation typical of the diploid species of *Stiposorghum.* The position of the nucleolus organizing region was determined for each chromosome. In one chromosome, the nucleolus organizing region was terminal, and in the other, subterminal; the former chromosome was noticeably shorter than the latter at pachytene. The presence of a terminal nucleolus organizing region suffices to distinguish *S. matarankense* from the other diploid species of *Stiposorghum* in which none of the nucleolus organizing regions is terminal.

Summary

Cytotaxonomic methods have been indispensable tools for arriving at conclusions as to taxonomic relationships and evalua-

tion within the complex genus *Sorghum,* especially in the subgenera *Para-Sorghum* and *Stiposorghum.*

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EVIDENCE FOR THE HYBRID NATURE OF X LIATRIS CREDITONENSIS

L. O. Gaiser

This paper[1] is concerned with a plant described by the author (1946) as a putative hybrid between *Liatris ligulistylis* and *L. squarrosa* var. *glabrata,* under the name of × *L. creditonensis.* Because of the practical difficulty of controlled breeding of Compositae, it has not been possible to demonstrate the hybrid nature of × *L. creditonensis* by planned resynthesis. The available evidence that it is a hybrid is here presented.

Liatris ligulistylis (Nels.) K. Sch. has a known range of the three prairie provinces of western Canada and southward along the eastern side of the Rocky Mountains through western South Dakota, Wyoming, and Colorado into northern New Mexico. It favors comparatively moist habitats. *Liatris squarrosa* (L.) Michx. var. *glabrata* (Rydb.) Gaiser on the otherhand is found on the dry open plains from Kansas to South Dakota. The ranges of these two entities do not overlap.

A garden plot of thirty-two plants of *L. squarrosa* var. *glabrata* (Accession No. 9) planted in 1928 from seed collected in Nebraska (high cliff northwest of Royal, Antelope County, 4 October 1927, *Wernicke*) developed into uniform, one-stemmed plants during their second year of growth, and by 1933 when they were five years old they had become several stemmed (Pl. 1, fig. 1). Growing beside this plot were two plants of *L. ligulistylis* (Acces-

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